(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
4 April 2002 (04.04.2002)

PCT

(10) International Publication Number
WO 02/26143 A1

(51) International Patent Classification[7]: A61B 17/42

(21) International Application Number: PCT/US01/30089

(22) International Filing Date:
26 September 2001 (26.09.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/235,939 27 September 2000 (27.09.2000) US

(71) Applicant *(for all designated States except US)*: **APPLIED MEDICAL RESOURCES** [US/US]; 22872 Avenida Empresa, Rancho Santa Margarita, CA 92688 (US).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **KAHLE, Henry** [US/US]; 25 Wrangler Court, Trabuco Canyon, CA 92679 (US). **SAKAKINE, Ghassan** [LB/US]; 21948 Mirador, Mission Viejo, CA 92691 (US). **GADBERRY, Donald, L.** [US/US]; 33862 Mariana Drive, Apartment B, Dana Point, CA 92629 (US).

(74) Agent: **MYERS, Richard, L.**; 22872 Avenida Empresa, Rancho Santa Margarita, CA 92688 (US).

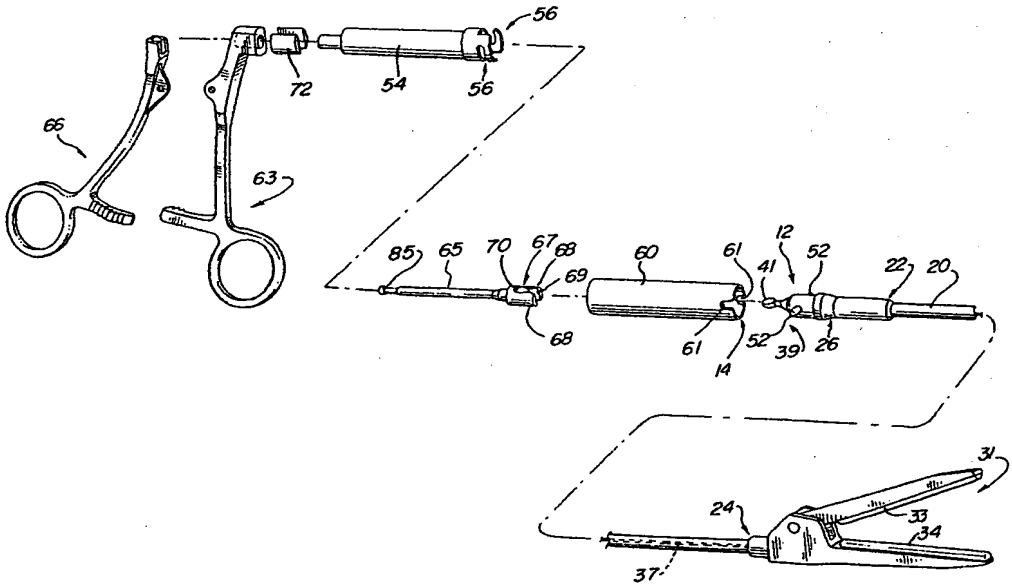
(81) Designated States *(national)*: CA, JP, US.

(84) Designated States *(regional)*: European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR).

Published:
— *with international search report*
— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: SURGICAL APPARATUS WITH DETACHABLE HANDLE ASSEMBLY



(57) Abstract: A surgical apparatus (10) comprises a handle assembly (14) removably coupled to an operative assembly (12). The handle assembly (14) comprises a pair of handles (63, 66), a housing (54), a link (66) disposed within the housing (54), and a retractable sleeve (60). The operative assembly (12) includes a shaft (20), a shaft connector (26), an operative mechanism (31), an actuator (37) coupled to the operative mechanism (31) and extending through the shaft (20), and an actuator connector (39) coupled to the actuator (37). The link (66) is removably coupled to an actuator connector (37) and a first handle (66) such movement of the first handle (66) effects movement of the operative mechanism (31). The housing (54) is removably coupled to the shaft connector (26).

WO 02/26143 A1

SURGICAL APPARATUS WITH DETACHABLE HANDLE ASSEMBLY

Related Applications

This application relates to and claims priority from U.S. Provisional Application Serial No. 60/235,939 entitled FLEXIBLE OCCLUSION SYSTEM CONNECTION filed on September 27, 2000, which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. *Field of the Invention*

The present invention relates generally to medical and surgical devices, and more specifically to devices incorporating handle assemblies.

2. *Description of Prior Art and Related Information*

Handle assemblies are generally provided for medical devices which include some type of operative mechanism at a distal end of an elongate shaft. Such devices provide access into particular body regions which may be difficult otherwise to reach. For example, a common surgical device incorporating a handle assembly is a surgical clamp device. The clamp arms are located at the distal end of an elongate shaft. A cable coupled to the clamp arms extends through the shaft and out a proximal end where it then connects to a handle of a conventional handle assembly.

In a conventional clamp apparatus, the cable is permanently secured to the handle of the handle assembly. While the cable remains attached to the handle assembly, the shaft may be detachable in order to save space. The user of the device may then assemble the shaft to the handle assembly on site. The typical means for joining the shaft to the handle assembly includes an externally threaded connector on a proximal portion of the shaft that mates with an internally threaded barrel of the handle assembly. This presents several drawbacks.

Threads are subject to wear and tear, especially during cleaning. With damaged threads, the entire apparatus may be rendered useless which can lead to high costs since the components are typically composed of metal. Furthermore, threads are also subject to damage upon assembly if the connector is not properly screwed to the barrel

of the handle assembly. Through continual usage and repeated cleaning cycles, the conventional clamp device has a short lifespan due to the high probability of damage occurring to the threads.

On the manufacturing side, a typical clamp device is expensive not only because the components are composed of metal, but also because machining is required to form the threads on the components.

With the cable permanently secured to the handle assembly, another apparent disadvantage of a conventional clamp device is the incompatibility of the handle assembly with any other operative assembly. A surgical clamp device of the prior art will always remain a surgical clamp device. Since the handle assembly is permanently affixed to the cable of the shaft, no option is provided for the handle assembly to be detached and joined to other operative assemblies. Furthermore, even if the prior art includes a handle assembly removably coupled to a cable of an operative assembly, the internally threaded barrel of the conventional handle assembly necessarily requires any additional operative assembly to have corresponding external threads that would mate properly.

SUMMARY OF THE INVENTION

The present invention provides structures and methods which overcome the deficiencies of the prior art.

In one aspect, a quick-release system is provided for a medical shaft having a retractable actuator. The system comprises an actuator connector, a shaft connector, a link removably coupled to the actuator connector, a handle coupled to the link, a housing removably coupled to the shaft connector, and a retractable sleeve disposed around the housing and the link, the sleeve being axially movable with respect to the housing.

Each of the preferred embodiments comprise a threadless connection between a the actuator and the link, as well as between the housing and the shaft connector, thus overcoming the deficiencies common in prior art devices. In one embodiment, the actuator connector comprises a ball, and the link defines a socket configured to receive the ball. The shaft connector comprises a retention rib. The housing defines a retention slot configured to receive the retention rib. The actuator connector is rotationally fixed with respect to the shaft connector. In another embodiment, the actuator connector comprises a bayonet, and the link defines a bayonet slot having a distal opening and a cavity that is wider than the distal opening. The shaft connector comprises a pin. The housing comprises a cylinder defining a track for receiving the pin. The track comprises an axial section and a transverse section.

The retractable sleeve is movable between a distal position and proximal position, the sleeve being biased toward the distal position. The link is axially movable with respect to the housing between a distal position and a proximal position. The link is biased to the distal position. The link is disposed substantially within the housing and removably coupled to the handle. The system preferably comprises a second handle coupled to the housing.

In a further aspect, a surgical apparatus comprises a shaft having a shaft proximal end and a shaft distal end, and a shaft connector coupled to the shaft proximal end. The shaft connector defines an axis and comprises a projection extending transverse to the axis. The handle assembly is removably coupled to the shaft connector. A housing included in the handle assembly comprises portions defining a slot for releasably receiving the projection. A sleeve is included in the handle assembly. The sleeve is coaxially movable between a proximal, open position in which

the shaft connector is in a detachable relationship with the housing, and a distal, closed position in which the shaft connector is in a locked relationship with the housing.

In a bayonet-type embodiment, the projection comprises a first pin. The shaft connector further comprises a second pin projecting oppositely from the first pin. The slot comprises a first bayonet track. The housing further comprises a second bayonet track configured to receive the second pin. Each bayonet track comprises an axial section and a transverse section. By axially moving the pins into the bayonet tracks, the distally biased sleeve is automatically retracted. Since the movement of the pins moves the sleeve, no other manipulation is required to retract the sleeve. The pins are moved to the end of the axial section, at which they are rotated with respect to the housing to travel to the ends of the transverse section. At this point, the distally biased sleeve automatically protracts as its recesses, now aligned with the pins, move distally to receive and lock the pins. The protracted sleeve blocks at least a portion of each track to restrict movement of the pins.

In a further aspect, a surgical apparatus comprises an operative assembly and a handle assembly removably coupled to the operative assembly without the use of threads. The operative assembly comprises a shaft having a shaft distal end and a shaft proximal end, an operative mechanism coupled to the shaft distal end, a shaft connector coupled to the shaft proximal end, the shaft connector defining an axis and comprising a transverse projection, an actuator disposed within the shaft, the actuator having an actuator distal end coupled to the operative mechanism and an actuator proximal end, and an actuator connector coupled to the actuator proximal end.

The handle assembly comprises a first releasable lock coupled to the shaft connector, the first releasable lock defining a space configured to receive the projection, a second releasable lock coupled to the actuator connector, and a handle coupled to the second releasable lock, whereby movement of the handle effects movement of the operative mechanism. The handle assembly further comprises a sleeve disposed around the releasable locks and coaxially movable with respect to the first releasable lock. The operative mechanism may comprise a clamp, a pair of scissors, a balloon, or any other mechanism which may benefit.

In a preferred embodiment, the actuator connector comprises a ball, and the second releasable lock defines a rounded slot for receiving the ball. The projection comprises a retention rib. The space of the first releasable lock comprises a retention

slot configured to receive the retention rib. With the sleeve retracted, the operative assembly is transversely brought toward the handle assembly, such as by lowering the operative assembly into the handle assembly. As a result, the ball and retention rib are placed in the rounded slot and retention slot, respectively.

In another preferred embodiment, the actuator connector comprises a bayonet, and the second releasable lock defines a bayonet slot for receiving the bayonet. The projection comprises a pin. The space of the first releasable lock comprises a bayonet track for receiving the pin. In this embodiment, the operative assembly and handle assembly are brought together axially, with the sleeve being automatically retracted by the axial movement of the shaft connector. In both embodiments, it will be appreciated that no threaded connections are made.

A system of interchangeable parts is also provided such a single handle assembly may be compatible with a plurality of different operative assemblies serving different functions. The system includes a plurality of detachable operative assemblies with different operative mechanisms and substantially similar shaft connectors. Each of the operative assemblies comprises a shaft with a shaft distal end and a shaft proximal end, an associated one of the operative mechanisms at the shaft distal end, an associated one of the substantially similar shaft connectors adjacent to the shaft proximal end, an actuator disposed within the shaft and coupling the operative mechanism to the engagement mechanism, an actuator connector coupled to the actuator and disposed adjacent to the shaft proximal end, and a releasable handle assembly compatible with each operative assembly. Each shaft connector defines an axis and comprises a projection extending transverse to the axis.

The handle assembly has characteristics facilitating a releasable connection with each operative assembly. The handle assembly comprises a housing configured to be removably coupled to the shaft connector of each operative assembly, the housing defining a space configured to receive the projection of each shaft connector, and a link configured to be removably coupled to the actuator connector of each operative assembly. The releasable handle assembly further comprises a handle coupled to the link. The releasable handle assembly further comprises a retractable sleeve coaxially movable between a distal position and a proximal position. The sleeve is biased toward the distal position. The various operative mechanisms may include clamps, pairs of scissors, balloons, and more.

In another aspect, a surgical apparatus includes an operative assembly and a handle assembly removably coupled to the operative assembly without threads. The operative assembly comprises a shaft with a shaft proximal end and a shaft distal end, an operative mechanism coupled to the shaft distal end, a shaft connector coupled to the shaft proximal end, the shaft connector defining an axis and including a projection extending transverse to the axis, an actuator connector disposed adjacent to the shaft proximal end, the actuator connector including a ball, and an actuator extending through the shaft and coupling the operative mechanism to the actuator connector.

The handle assembly comprises a housing removably coupled to the shaft connector, the housing defining a first slot configured to receive the projection, a releasable lock removably coupled to the actuator connector, the releasable lock defining a second slot configured to receive the ball, a handle coupled to the releasable lock, and a coaxially movable sleeve.

The projection comprises a retention rib. The housing comprises an at least partially cylindrical wall, the first slot being defined on an inner surface of the cylindrical wall. The retractable sleeve is movable between a biased, distal position which facilitates locking of the operative assembly, and a proximal position which facilitates removal of the operative assembly.

In a further aspect, a medical apparatus is provided. The medical apparatus comprises an operative assembly and a handle assembly removably coupled to the operative assembly without threads. The operative assembly comprises a shaft with a shaft proximal end and a shaft distal end, an operative mechanism coupled to the shaft distal end, an actuator connector disposed adjacent to the shaft proximal end, the actuator connector including a first bayonet, an actuator extending through the shaft and coupling the operative mechanism to the actuator connector, and a shaft connector coupled to the shaft proximal end, the shaft connector defining an axis and including a second bayonet extending transverse to the axis.

The handle assembly comprises a releasable lock removably coupled to the actuator connector, the releasable lock defining a first slot configured to receive the first bayonet, a housing removably coupled to the shaft connector, the housing defining a second slot configured to receive the second bayonet, and a handle coupled to the releasable lock. The first slot comprises a bayonet slot having an exit hole that is smaller than a cavity. The second bayonet comprises a pin. The housing comprises

an at least partially cylindrical wall. The second slot comprises a track including an axially extending distal section and a transversely extending proximal section. The handle assembly further comprises a coaxially movable sleeve disposed around the housing and the releasable lock.

A method for assembling a medical apparatus is also provided. The method comprises the steps of providing an operative assembly with an actuator connector and a shaft connector, providing a handle assembly separate from the operative assembly, coaxially retracting a sleeve of the handle assembly, coupling the actuator connector to a link of the handle assembly, and coupling the shaft connector to a housing of the handle assembly. The method further comprises the step of coaxially protracting the sleeve.

In one embodiment, the step of coupling the actuator connector to a link of the handle assembly comprises the step of placing the actuator connector into a slot defined by the link. The step of placing the actuator connector into a slot defined by the link comprises the step of lowering the actuator connector into the slot. The step of coaxially retracting a sleeve of the handle assembly comprises the step of exposing the slot defined by the link. The step of coupling the shaft connector to a housing of the handle assembly comprises the step of placing a projection of the shaft connector into a corresponding housing slot. In this embodiment, the step of coaxially retracting a sleeve of the handle assembly comprises the step of exposing the housing slot.

In another embodiment, the step of coupling the shaft connector to a link of the handle assembly comprises the step of twisting the operative assembly with respect to the handle assembly. The step of coupling the actuator connector to a housing of the handle assembly comprises the step of twisting the operative assembly with respect to the handle assembly. The sleeve automatically protracts when its recesses are aligned with pins of the operative assembly, which alignment occurs after twisting.

A method for assembling a medical device is provided as well. The method comprises the steps of providing operative assembly with a shaft connector and an actuator connector, forming a first bayonet on the actuator connector, forming a second bayonet on the shaft connector, providing a handle assembly separate from the operative assembly, forming in the handle assembly a first slot for receiving the first bayonet and a second slot for receiving the second bayonet, and removably coupling the operative assembly to the handle assembly using a bayonet motion.

The step of removably coupling the operative assembly to the handle assembly using a bayonet motion comprises the steps of aligning the first bayonet with the first slot, aligning the second bayonet with the second slot, inserting the first bayonet into the first slot, inserting the second bayonet into second first slot, and rotating the operative assembly with respect to the handle assembly.

The method further comprises the step of providing the handle assembly with a coaxially retractable sleeve disposed at least partially over the first slot and the second slot. The step of inserting the second bayonet into the second slot comprises the step of automatically retracting the sleeve. The step of rotating the operative assembly with respect to the handle assembly comprises the step of automatically protracting the sleeve.

Since each embodiment employs a threadless connection, it will be noted that the methods do not require screwing one assembly onto another. Joining the operative assembly to the handle assembly simply requires bringing the two assemblies together, either axially or transversely. Not only are the methods of assembly conveniently simple, the types of connections provided by the embodiments are secure. Obviating the use of threads further increases the lifespan of the assemblies, which will be appreciated as, for example, a handle assembly may be repeatedly detached and coupled to a variety of different operative assemblies.

In summary, a surgical apparatus comprises a handle assembly removably coupled to an operative assembly. The handle assembly comprises a pair of handles, a housing, a link disposed within the housing, and a retractable sleeve. The operative assembly includes a shaft, a shaft connector, an operative mechanism, an actuator coupled to the operative mechanism and extending through the shaft, and an actuator connector coupled to the actuator. The link is removably coupled to an actuator connector and a first handle such movement of the first handle effects movement of the operative mechanism. The housing is removably coupled to the shaft connector.

The invention, now having been briefly summarized, may be better appreciated by the following description of preferred embodiments and reference to the associated drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an exploded, perspective view of a first preferred embodiment of a surgical apparatus;

FIG. 2 is a top plan view of the first preferred surgical apparatus in part, with a shaft assembly partially assembled to a handle assembly;

FIG. 3 is a top plan view of the first preferred surgical apparatus fully assembled;

FIG. 4 is a side elevation view of the first preferred surgical apparatus;

FIG. 5 is an axial cross-sectional view of FIG. 4;

FIG. 6 is an exploded, perspective view of an alternate shaft connector and alternate actuator connector;

FIG. 7 is a perspective view of the alternate shaft connector and alternate actuator connector of FIG. 5;

FIG. 8 is a partially exploded view of a second preferred embodiment of a surgical apparatus;

FIG. 9 is a perspective view of the second embodiment of the surgical apparatus in an extended state;

FIG. 10 is a perspective view of the second embodiment of the surgical apparatus in a détente, retracted state;

FIG. 11 is a side elevation view of the surgical apparatus with jaws in an open state;

FIG. 12 is a side elevation view of the surgical apparatus with jaws in a closed state; and

FIG. 13 is a side elevation view of an alternative operative mechanism.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS AND BEST MODE OF THE INVENTION

The invention and its various embodiments can now be better understood with the following detailed description wherein illustrated embodiments are described. It is to be expressly understood that the illustrated embodiments are set forth as examples and not by way of limitations on the invention which is ultimately defined in the claims.

A first preferred embodiment of a surgical apparatus is illustrated in Figure 1 and designated generally by the reference numeral 10. This surgical apparatus, or simply apparatus 10, comprises an operative assembly 12 and a handle assembly 14 removably coupled thereto. It will be appreciated that the detachability of the assemblies 12, 14 increases compatibility of the apparatus 10. In particular, the reusable handle assembly 14, which is generally formed of more expensive material such as stainless steel, may be coupled to a variety of operative assemblies having different operative mechanisms, as described further below.

In Figure 1, the operative assembly 12 comprises a shaft 20 having a shaft proximal end 22 and a shaft distal end 24. A shaft connector 26 is coupled to the shaft distal end 24. The shaft connector 26 may be formed integrally with the shaft 20. In a preferred embodiment, the shaft 20 comprises a semi-rigid shaft 20 having properties for being manually moved to a desired shape and for maintaining the desired shape upon release. The shaft 20 is thus semi-rigid with characteristics for being sufficiently bendable so as to permit movement to a desired shape prior to operation of the apparatus 10, but sufficiently rigid so as to maintain the desired shape during operation of the apparatus 10. In several embodiments, these semi-rigid characteristics are facilitated by providing an outer jacket in the form of a corrugated tube, a malleable metallic tube, and/or a series of ball-and-socket joints.

The operative assembly 12 includes an operative mechanism 31 disposed adjacent to the shaft distal end 24. In the first preferred embodiment shown in Figure 1, the operative mechanism comprises a clamp having a pair of jaws 33, 34. As will be described in further detail below, the operative assembly 12 may be provided with a variety of different operative mechanisms having different functions, thereby expanding the capabilities of the apparatus 10.

An actuator assembly 35 couples the operative mechanism 31 to the handle assembly 14. The actuator assembly 35 includes an actuator, preferably a cable 37,

extending through the shaft 20. The cable 37 couples the jaw 33 adjacent to the shaft distal end 24 to an actuator connector 39 adjacent to the shaft proximal end 22, as best shown in Figure 5. The actuator assembly 35 thus enables movement of one of the moving members 33, 34 of the operative mechanism 31 through movement of the handle assembly 14 as described below.

In the first preferred embodiment shown in Figures 1-5, the actuator connector 39 comprises a tip shaped as a bayonet 41. The actuator bayonet 41 comprises a substantially flat, circular head having a width, best shown by the arrow 43 in Figure 3, greater than its thickness, best shown by the arrow 45 in Figure 2. To enable microadjustment of the operative mechanism 31 with respect to the handle assembly 14, the actuator connector 39 comprises an internally threaded bore 47 configured to receive an externally threaded member 49 connected to a distal end of the cable 37 as shown in Figure 5.

The shaft connector 26 defines an axis "X" and comprises a shaft bayonet 50 with projections 52 which extend transversely to the axis "X". The projections 52 are preferably formed as a pair of oppositely protruding pins 52, which may be separate from the shaft connector body 53 as shown in Figures 1-5, or integral therewith as shown in an alternative embodiment in Figures 6 and 7. In Figure 1, the actuator bayonet 41 and shaft bayonet 50 are configured to fit and lock to corresponding structures in the handle assembly 14.

The handle assembly 14 comprises a housing 54 that defines first and second bayonet slots, or tracks, 56 shaped to receive the pins 52 of the shaft connector 26. Each track 56 comprises a first, axial section, or axial opening 57, and a second, transverse section 58. A retractable collet, preferably formed as a cylindrical sleeve, 60 disposed over the housing 54, defines a pair of opposite recesses 61 also configured to receive the pins 52. The sleeve 60 is spring biased toward a distal direction and, thus, movable with respect to the housing 54. The housing 54 is coupled to a first handle 63 which may be formed integrally therewith.

A link 65 is coupled to a second handle 66, which is preferable formed separately. The link 65 defines a distal bayonet cavity 67 configured to receive the actuator bayonet 41. In particular, the cavity 67 has a distal opening 69 that is more narrow than a main body 70. Alternatively stated, the bayonet cavity 67 is defined by a

pair of distally extending arms 68 having transverse protuberances 71 that face each other, thereby defining the narrow distal opening 69.

Figures 2-4 illustrate a method for coupling the operative assembly 12 to the handle assembly 14. In Figure 2, the operative assembly 12 and the handle assembly 14 are brought toward each other axially. The assemblies 12, 14 are configured such that when the shaft connector pins 52 are aligned with axial openings 57 of the housing 54, the actuator bayonet 41 is aligned with the bayonet cavity 67. By simply moving the assemblies 12, 14 into each other axially, the shaft connector pins 52 automatically retracts the sleeve 60 while the actuator bayonet 41 enters the bayonet cavity 67. With a single twisting motion, the shaft connector pins 52 travel along the transverse sections 58 of the bayonet slots 56 until they reach the ends thereof. At this point the sleeve 60 is automatically moved forward by virtue of the spring as the pins 52 are now aligned with and received within the recesses 61. Concurrently, the actuator bayonet 41 is rotated within the bayonet cavity 67 such that its width 43 is obstructed by narrow opening 69 as shown in Figure 3. The bayonet cavity 67 thus traps the actuator bayonet 41 while the recesses 61 trap the pins 52.

It will be appreciated that by axially joining the two assemblies 12, 14 and twisting one assembly with respect to the other, the assemblies 12, 14 are engaged and the apparatus 10 ready for operation. A major advantage in the assembly method provided by the structure of the apparatus 10 is that the distally biased sleeve 60, which serves to lock the shaft connector pins 52 and thus fix the operative assembly 12 in place, need not be retracted separately by the user when assembling the apparatus 10. The retraction is automatically performed when the assemblies 12, 14 are brought together in alignment. It will further be appreciated that with the sleeve 60 biased toward a distal direction, the sleeve 60 automatically slides distally in place when the pins 52 are twisted to the point of being aligned with the recesses 61.

To disassemble the apparatus 10, the sleeve 60 is retracted, or moved in a proximal direction, thereby freeing the pins 52. The operative assembly 12 is rotated, or twisted, with respect to the handle assembly 14 such that the pins 52 travel along the transverse sections 58 of the slots 56 toward the axial openings 57. The operative assembly 12 may then be axially withdrawn from and thereby axially separated from the handle assembly 14. The spring biased sleeve 60 then automatically slides distally.

Thus, the housing 54 comprises a releasable lock for the shaft connector 26 while the link 65 comprises a releasable lock for the actuator connector 39.

Figure 5 is a top, axial cross-section view taken of Figure 4. A spacer 72 is disposed between proximal portions 74, 76 of the sleeve 60 the housing 54, respectively. The spacer 72 includes a shoulder 78 for abutting a first, outer coil spring 80 that biases the sleeve 60 distally. The coil spring 80 is disposed in an annular gap 82 between the inner surface of the sleeve 60 and the outer surface of the housing 54. A second, inner coil spring 84 disposed within the housing 54 biases the link 65 distally. The distally biased link 65 comprises a proximal ball 85 that is received in a socket 86 defined in the second handle 66.

In Figure 5, a third spring 88 disposed within the shaft connector 26 biases the actuator connector 39 proximally with respect to the shaft connector 26. The actuator connector 39 also comprises axial grooves 91 configured to slidingly receive the pins 52. The actuator connector 39 is thus rotationally fixed with respect to the shaft connector 26.

Figures 6 and 7 illustrate further embodiments of a shaft connector 26a and actuator connector 39a. In these embodiments, structural elements corresponding to those previously described are designated by the same reference numeral followed by the letter "a". The shaft connector 26a comprises integral pins 52a. A distal portion 92 of the shaft connector 26a defines a key hole 94 configured for receiving a key 96. In a preferred embodiment, the key hole 94 comprises a recess 98 formed in an outer wall 101, and grooves 103 formed in an inner wall 105 of the shaft connector 26a. The key 96 thus comprises a bump 107 adapted to fit into the recess 98 and a body 109 adapted to fit into the grooves 103. The key 96 is slidingly coupled to the actuator connector 39a.

In a further preferred embodiment illustrated in part in Figures 8-10, structural elements corresponding to those previously described are designated by the same reference numeral followed by the letter "b". In this surgical apparatus 10b shown in Figure 8, a shaft connector 26b of an operative assembly 12b includes a retention rib 111 extending transversely to the axis "X" and a bump 113, preferably formed as a rim. Accordingly, a sleeve 60b of a handle assembly 14b comprises a top recess 115 configured to abut the bump 113 while the housing 54b includes a slot 117 configured to receive the retention rib 111. The housing 54b further includes distal alignment

prongs 119 to abut the rim 113 of the shaft connector 26b. The actuator connector 39b includes a ball 121 configured to fit into a distal socket 123 defined in a link 65b.

A method of assembly of the apparatus 10b includes retracting the sleeve 60b to expose the socket 103. The operative assembly 12b is lowered into the handle assembly 14b. Thus, the assemblies 12b, 14b are brought toward each other in a transverse direction perpendicular to the axis "X". With the alignment prongs 119 abutting the rim 113, the ball 121 is received in the socket 123 of the link 65b, and the retention rib 111 is received in the slot 117 of the housing 54b as best shown in Figure 9. By releasing the spring biased sleeve 60b as shown in Figure 10, the sleeve 60b automatically moves distally to cover the ball (not shown) and abut the rim 113, thus securing the operative assembly 12b to the handle assembly 14b.

Figures 11 and 12 illustrate a preferred method of operation of the surgical apparatus 10, which method applies to each of the above embodiments of the surgical apparatus. By moving the handles 63, 66 toward each other, the second handle 66 which is coupled to the actuator 39 causes the connected, pivotal jaw 33 to pivot and move proximately toward the stationary jaw 34. Ratcheted members 125 are provided on the handles 63, 66 to enable the handles 63, 66 to maintain a fixed position, thus maintaining a fixed position of the jaws 33, 34. Moving the handles 63, 66 away from each causes the jaws 33, 34 to move apart.

In the above embodiments, it will be noted that a handle assembly is removably coupled to an operative assembly with a first releasable lock configured for the shaft connector and a second releasable lock configured for the actuator connector.

In Figure 13, a combination, or system 200, of interchangeable parts is provided as the handle assembly 14 may be repeatedly detached from a particular operative assembly 12, 112, 212, and coupled to a different operative assembly 12, 112, 212. The system comprises a handle assembly 14 that is compatible with a plurality of different operative assemblies 12, 112, 212, each having a different operative mechanism 31, 131, 231, respectively. For example, the operative mechanisms 31, 131, 231 of the various operative assemblies 12, 112, 212 may comprise a clamp 31, a pair of scissors 131, and a balloon device 231. In fact, the operative mechanisms may comprise any device which utilizes the axial tensioning of a cable to move between a first state and a second state.

Many alterations and modifications may be made by those having ordinary skill in the art without departing from the spirit and scope of the invention. Therefore, it must be understood that the illustrated embodiments have been set forth only for the purposes of examples and that they should not be taken as limiting the invention as defined by the following claims. For example, notwithstanding the fact that the elements of a claim are set forth below in a certain combination, it must be expressly understood that the invention includes other combinations of fewer, more or different elements, which are disclosed in above even when not initially claimed in such combinations.

The words used in this specification to describe the invention and its various embodiments are to be understood not only in the sense of their commonly defined meanings, but to include by special definition in this specification the generic structure, material or acts of which they represent a single species.

The definitions of the words or elements of the following claims are, therefore, defined in this specification to not only include the combination of elements which are literally set forth. In this sense it is therefore contemplated that an equivalent substitution of two or more elements may be made for any one of the elements in the claims below or that a single element may be substituted for two or more elements in a claim. Although elements may be described above as acting in certain combinations and even initially claimed as such, it is to be expressly understood that one or more elements from a claimed combination can in some cases be excised from the combination and that the claimed combination may be directed to a subcombination or variation of a subcombination.

Insubstantial changes from the claimed subject matter as viewed by a person with ordinary skill in the art, now known or later devised, are expressly contemplated as being equivalently within the scope of the claims. Therefore, obvious substitutions now or later known to one with ordinary skill in the art are defined to be within the scope of the defined elements.

The claims are thus to be understood to include what is specifically illustrated and described above, what is conceptionally equivalent, what can be obviously substituted and also what incorporates the essential idea of the invention.

WHAT IS CLAIMED IS:

1. A quick-release system for a medical shaft having a retractable actuator, comprising:

an actuator connector;

a shaft connector;

a link removably coupled to the actuator connector;

a handle coupled to the link;

a housing removably coupled to the shaft connector; and

a retractable sleeve disposed around the housing and the link, the sleeve being axially movable with respect to the housing.

2. The system of Claim 1, wherein:

the actuator connector comprises a ball; and

the link defines a socket configured to receive the ball.

3. The system of Claim 1, wherein:

the actuator connector comprises a bayonet; and

the link defines a bayonet slot having a distal opening and a cavity that is wider than the distal opening.

4. The system of Claim 1, wherein:

the shaft connector comprises a retention rib; and

the housing defines a retention slot configured to receive the retention rib.

5. The system of Claim 1, wherein:

the shaft connector comprises a pin; and

the housing comprises a cylinder defining a track for receiving the pin.

6. The system of Claim 5, wherein the track comprises an axial section and a transverse section.

7. The system of Claim 1, wherein the actuator connector is rotationally fixed with respect to the shaft connector.

8. The system of Claim 1, wherein the retractable sleeve is movable between a distal position and proximal position, the sleeve being biased toward the distal position.

9. The system of Claim 1, wherein:

the link is axially movable with respect to the housing between a distal position and a proximal position; and

the link is biased to the distal position.

10. The system of Claim 1, wherein the link is disposed substantially within the housing and removably coupled to the handle.

11. The system of Claim 1, wherein the handle comprises a first handle, the system further comprising a second handle coupled to the housing.

12. A surgical apparatus comprising:

a shaft having a shaft proximal end and a shaft distal end;

a shaft connector coupled to the shaft proximal end, the shaft connector defining an axis and comprising a projection extending transverse to the axis;

a handle assembly removably coupled to the shaft connector;

a housing included in the handle assembly, the housing including portions defining a slot for releasably receiving the projection; and

a sleeve included in the handle assembly, the sleeve being coaxially movable between a proximal, open position in which the shaft connector is in a detachable relationship with the housing, and a distal, closed position in which the shaft connector is in a locked relationship with the housing.

13. The apparatus of Claim 12, wherein:

the projection comprises a first pin;

the slot comprises a first bayonet track:

the shaft connector further comprises a second pin projecting oppositely from the first pin; and

the housing further comprises a second bayonet track configured to receive the second pin.

14. The apparatus of Claim 13, wherein each bayonet track comprises an axial section and a transverse section.

15. The apparatus of Claim 14, wherein:

the sleeve is biased toward the distal position; and

the sleeve blocks at least a portion of each track to restrict movement of the pins.

16. The apparatus of Claim 15, wherein the sleeve further comprises opposite recesses configured to receive and lock the pins.

17. A surgical apparatus, including:

an operative assembly, comprising:

a shaft having a shaft distal end and a shaft proximal end,

an operative mechanism coupled to the shaft distal end,

a shaft connector coupled to the shaft proximal end, the shaft connector defining an axis and comprising a transverse projection,

an actuator disposed within the shaft, the actuator having an actuator distal end coupled to the operative mechanism and an actuator proximal end, and

an actuator connector coupled to the actuator proximal end; and

a handle assembly removably coupled to the operative assembly, the handle assembly comprising:

a first releasable lock coupled to the shaft connector, the first releasable lock defining a space configured to receive the projection,

a second releasable lock coupled to the actuator connector, and

a handle coupled to the second releasable lock, whereby movement of the handle effects movement of the operative mechanism.

18. The apparatus of Claim 17, wherein the handle assembly further comprises a sleeve disposed around the releasable locks and coaxially movable with respect to the first releasable lock.

19. The apparatus of Claim 17, wherein the operative mechanism comprises a clamp.

20. The apparatus of Claim 17, wherein the operative mechanism comprises a pair of scissors.

21. The apparatus of Claim 17, wherein:

the actuator connector comprises a ball; and

the second releasable lock defines a rounded slot for receiving the ball.

22. The apparatus of Claim 21, wherein:

the projection comprises a retention rib; and

the space of the first releasable lock comprises a retention slot configured to receive the retention rib.

23. The apparatus of Claim 17, wherein:

the actuator connector comprises a bayonet; and

the second releasable lock defines a bayonet slot for receiving the bayonet.

24. The apparatus of Claim 23, wherein:

the projection comprises a pin; and

the space of the first releasable lock comprises a bayonet track for receiving the pin.

25. A system of interchangeable parts, including:

a plurality of detachable operative assemblies with different operative mechanisms and substantially similar shaft connectors, each of the operative assemblies comprising:

a shaft with a shaft distal end and a shaft proximal end,

an associated one of the operative mechanisms at the shaft distal end,

an associated one of the substantially similar shaft connectors adjacent to the shaft proximal end, each shaft connector defining an axis and comprising a projection extending transverse to the axis,

an actuator disposed within the shaft and coupling the operative mechanism to the engagement mechanism,

an actuator connector coupled to the actuator and disposed adjacent to the shaft proximal end; and

a releasable handle assembly compatible with each operative assembly, the handle assembly having characteristics facilitating a releasable connection with each operative assembly, the handle assembly comprising:

a housing configured to be removably coupled to the shaft connector of each operative assembly, the housing defining a space configured to receive the projection of each shaft connector, and

a link configured to be removably coupled to the actuator connector of each operative assembly.

26. The system of Claim 25, wherein the releasable handle assembly further comprises a handle coupled to the link.

27. The system of Claim 25, wherein the releasable handle assembly further comprises a retractable sleeve coaxially movable between a distal position and a proximal position.

28. The system of Claim 27, wherein the sleeve is biased toward the distal position.

29. A surgical apparatus, including:

an operative assembly, comprising:

a shaft with a shaft proximal end and a shaft distal end,

an operative mechanism coupled to the shaft distal end,

a shaft connector coupled to the shaft proximal end, the shaft connector defining an axis and including a projection extending transverse to the axis,

an actuator connector disposed adjacent to the shaft proximal end, the actuator connector including a ball, and

an actuator extending through the shaft and coupling the operative mechanism to the actuator connector; and

a handle assembly removably coupled to the operative assembly, the handle assembly comprising:

a housing removably coupled to the shaft connector, the housing defining a first slot configured to receive the projection,

a releasable lock removably coupled to the actuator connector, the releasable lock defining a second slot configured to receive the ball,

a handle coupled to the releasable lock, and

a coaxially movable sleeve.

30. The apparatus of Claim 29, wherein:

the projection comprises a retention rib, and

the housing comprises an at least partially cylindrical wall, the first slot being defined on an inner surface of the cylindrical wall.

31. The apparatus of Claim 29, wherein retractable sleeve is movable between a biased, distal position which facilitates locking of the operative assembly, and a proximal position which facilitates removal of the operative assembly.

32. A medical apparatus comprising:

an operative assembly comprising:

a shaft with a shaft proximal end and a shaft distal end,

an operative mechanism coupled to the shaft distal end,

an actuator connector disposed adjacent to the shaft proximal end, the actuator connector including a first bayonet,

an actuator extending through the shaft and coupling the operative mechanism to the actuator connector,

a shaft connector coupled to the shaft proximal end, the shaft connector defining an axis and including a second bayonet extending transverse to the axis; and

a handle assembly removably coupled to the operative assembly, the handle assembly comprising:

a releasable lock removably coupled to the actuator connector, the releasable lock defining a first slot configured to receive the first bayonet,

a housing removably coupled to the shaft connector, the housing defining a second slot configured to receive the second bayonet, and

a handle coupled to the releasable lock.

33. The apparatus of Claim 32, wherein the first slot comprises a bayonet slot having an exit hole that is smaller than a cavity.

34. The apparatus of Claim 32, wherein:
the second bayonet comprises a pin, and
the housing comprises an at least partially cylindrical wall.

35. The apparatus of Claim 34, wherein the second slot comprises a track including an axially extending distal section and a transversely extending proximal section.

36. The apparatus of Claim 32, wherein the handle assembly further comprises a coaxially movable sleeve disposed around the housing and the releasable lock.

37. A method for assembling a medical apparatus, comprising the steps of:
providing an operative assembly with an actuator connector and a shaft connector;
providing a handle assembly separate from the operative assembly;
coaxially retracting a sleeve of the handle assembly;
coupling the actuator connector to a link of the handle assembly; and
coupling the shaft connector to a housing of the handle assembly.

38. The method of Claim 37, wherein the step of coupling the actuator connector to a link of the handle assembly comprises the step of placing the actuator connector into a slot defined by the link.

39. The method of Claim 38, wherein the step of placing the actuator connector into a slot defined by the link comprises the step of lowering the actuator connector into the slot.

40. The method of Claim 38, wherein the step of coaxially retracting a sleeve of the handle assembly comprises the step of exposing the slot defined by the link.

41. The method of Claim 37, wherein the step of coupling the shaft connector to a housing of the handle assembly comprises the step of placing a projection of the shaft connector into a corresponding housing slot.

42. The method of Claim 41, wherein the step of coaxially retracting a sleeve of the handle assembly comprises the step of exposing the housing slot.

43. The method of Claim 41, wherein the step of coupling the shaft connector to a link of the handle assembly comprises the step of twisting the operative assembly with respect to the handle assembly.

44. The method of Claim 41, wherein the step of coupling the actuator connector to a housing of the handle assembly comprises the step of twisting the operative assembly with respect to the handle assembly.

45. The method of Claim 37, further comprising the step of coaxially protracting the sleeve.

46. A method for assembling a medical device, comprising the steps of:

providing operative assembly with a shaft connector and an actuator connector;

forming a first bayonet on the actuator connector;

forming a second bayonet on the shaft connector;

providing a handle assembly separate from the operative assembly;

forming in the handle assembly a first slot for receiving the first bayonet and a second slot for receiving the second bayonet; and

removably coupling the operative assembly to the handle assembly using a bayonet motion.

47. The method of Claim 46, wherein the step of removably coupling the operative assembly to the handle assembly using a bayonet motion comprises the steps of:

aligning the first bayonet with the first slot;

aligning the second bayonet with the second slot;

inserting the first bayonet into the first slot;

inserting the second bayonet into second first slot; and

rotating the operative assembly with respect to the handle assembly.

48. The method of Claim 47, further comprising the step of providing the handle assembly with a coaxially retractable sleeve disposed at least partially over the first slot and the second slot.

49. The method of Claim 48, wherein the step of inserting the second bayonet into the second slot comprises the step of automatically retracting the sleeve.

50. The method of Claim 48, wherein the step of rotating the operative assembly with respect to the handle assembly comprises the step of automatically protracting the sleeve.

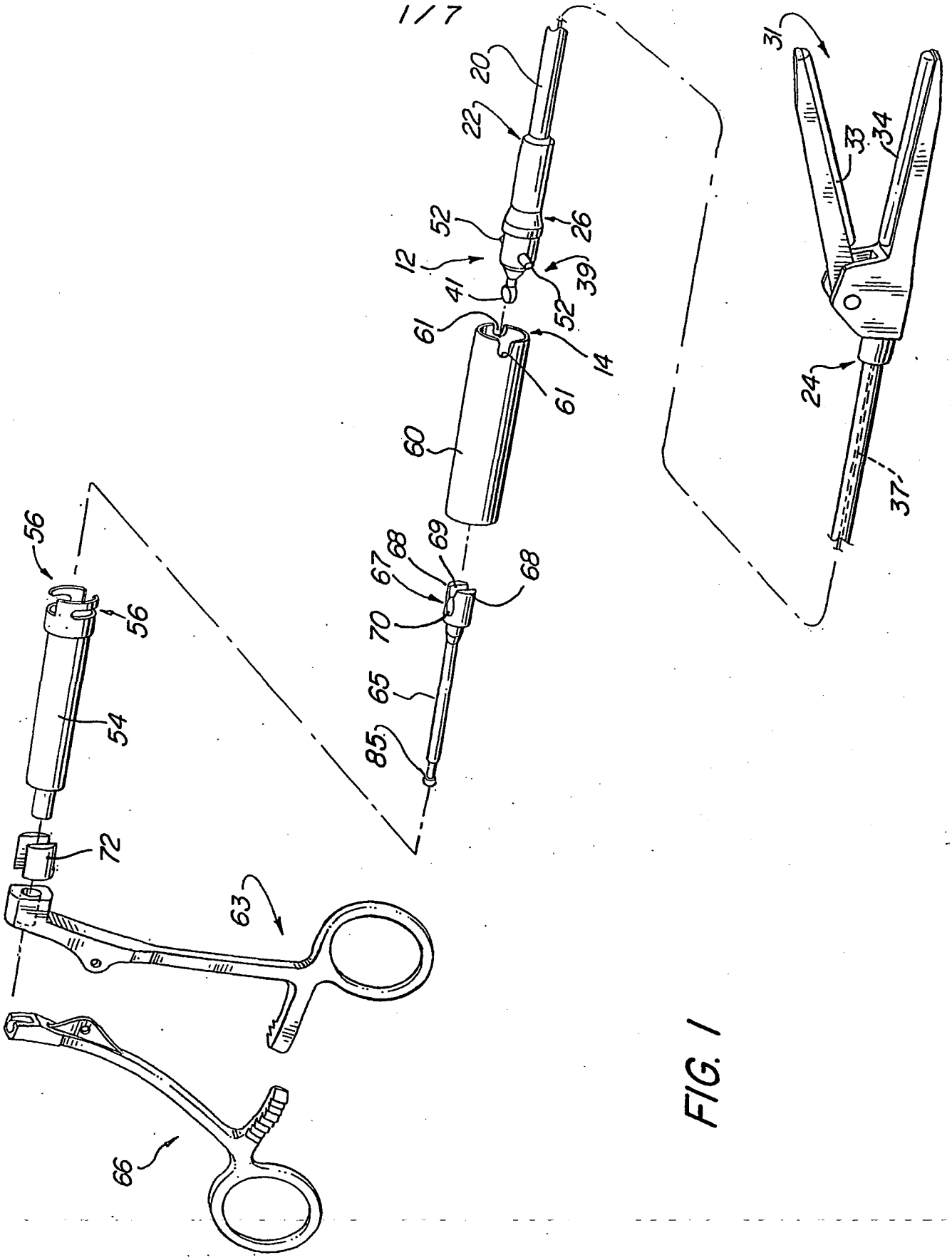


FIG. 1

FIG. 2

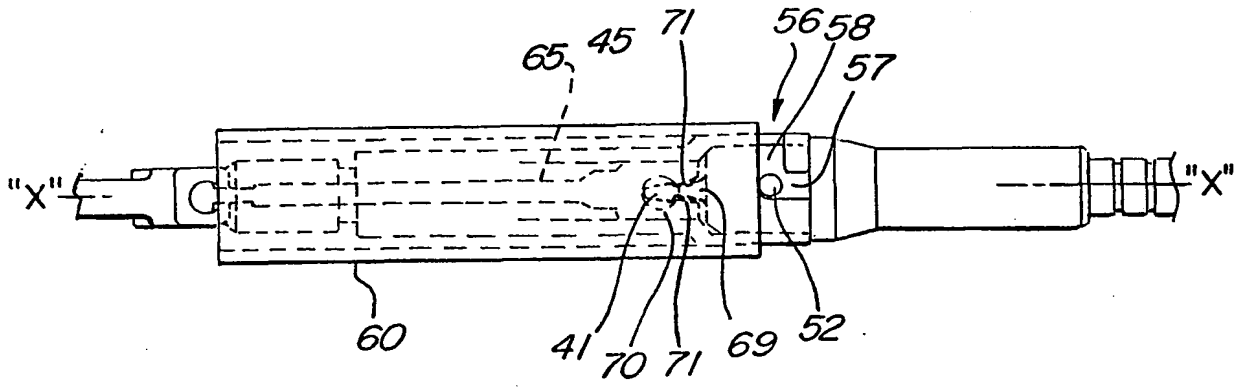


FIG. 3

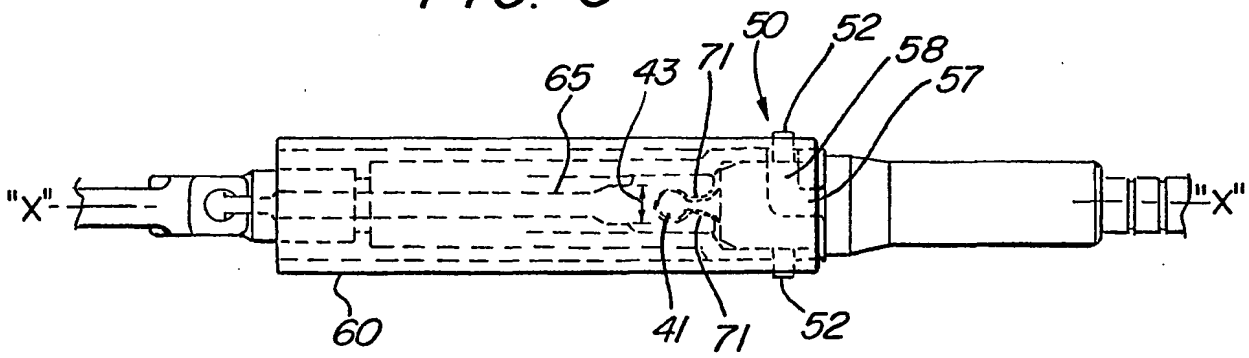


FIG. 4

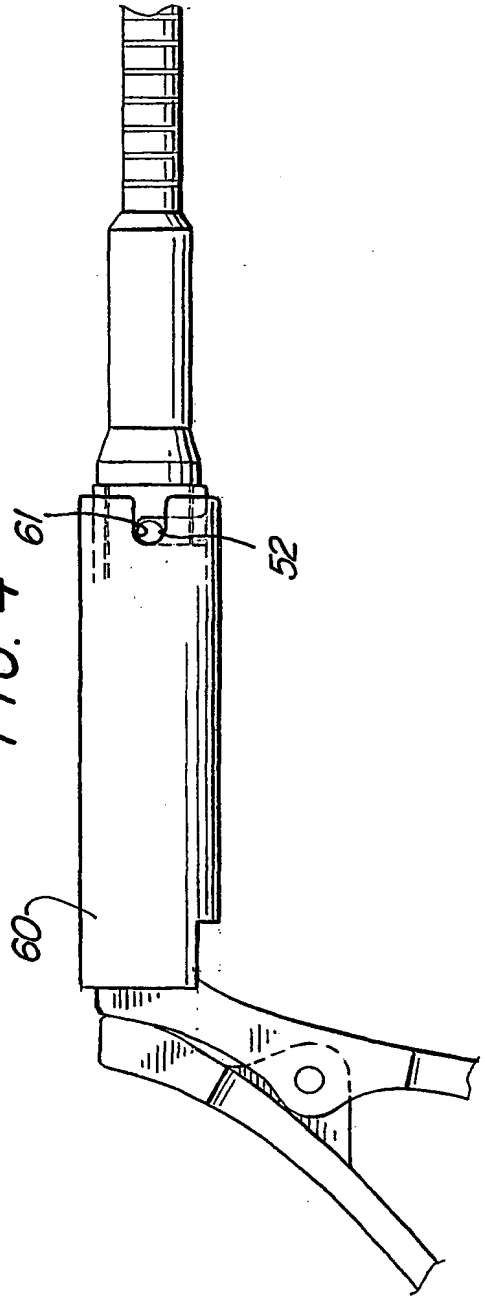


FIG. 5

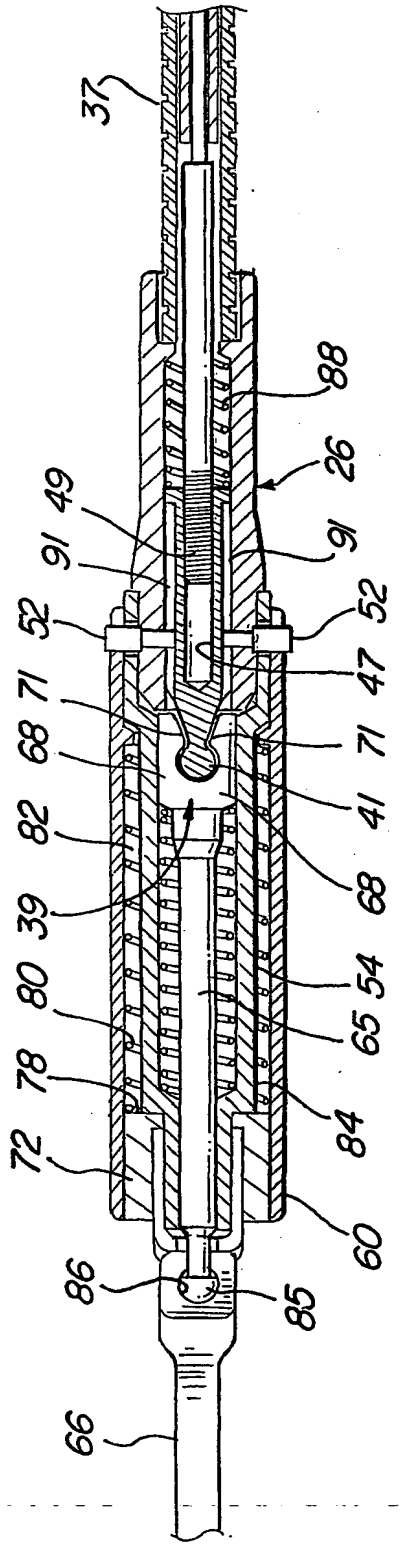


FIG. 6

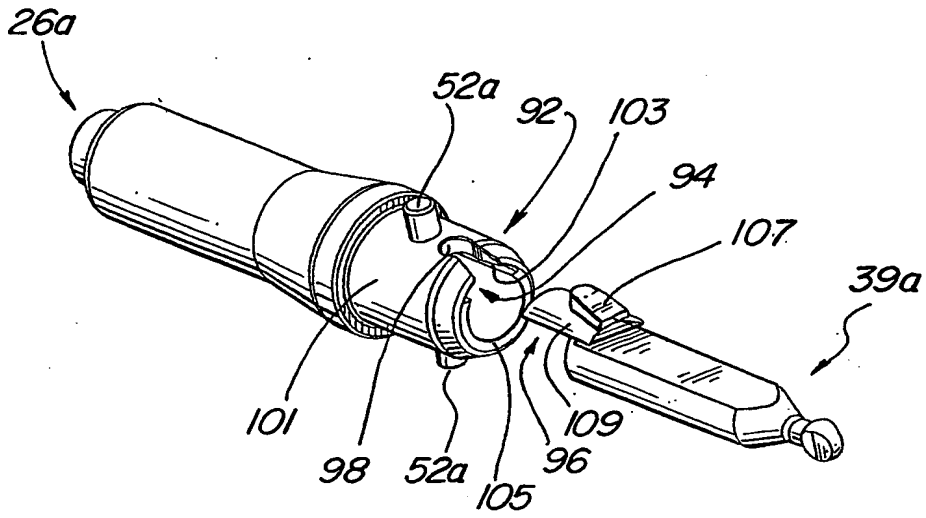


FIG. 7

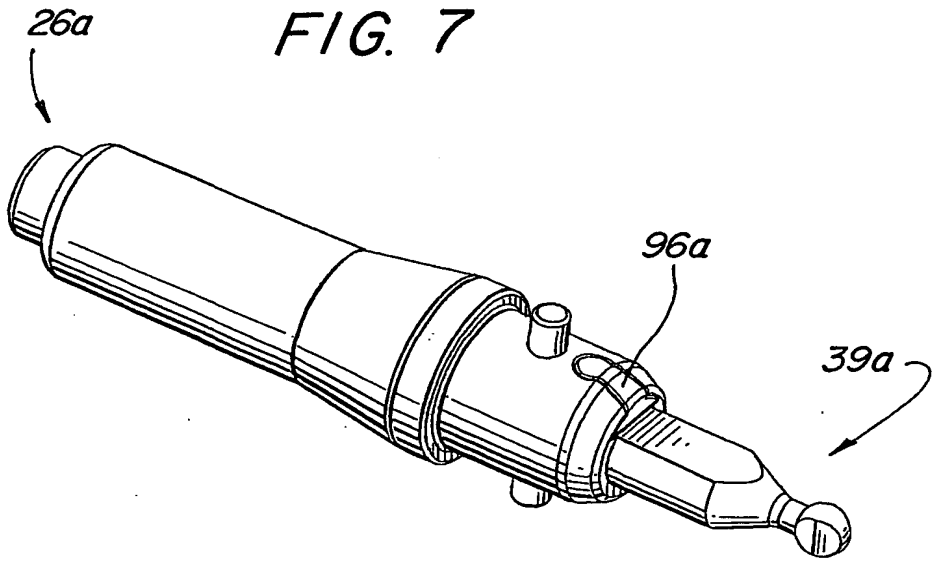


FIG. 8

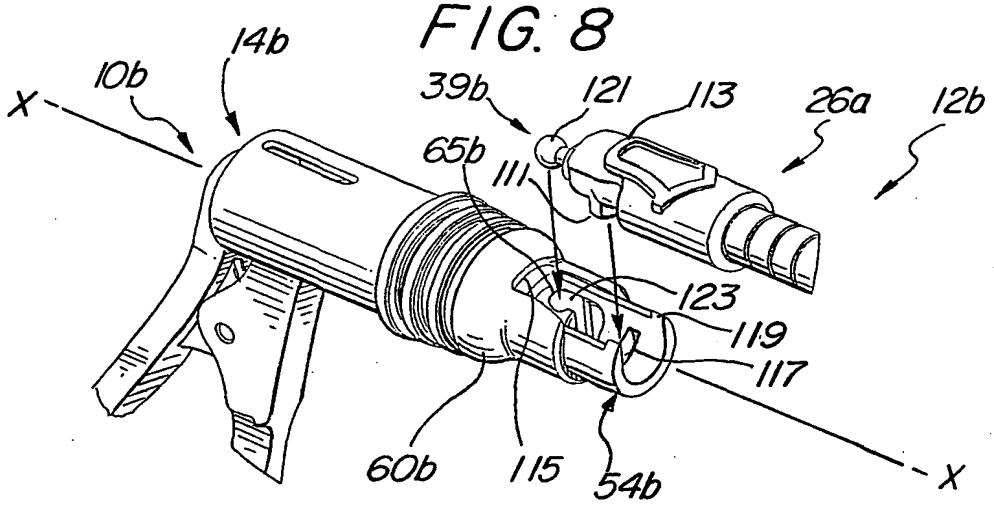


FIG. 9

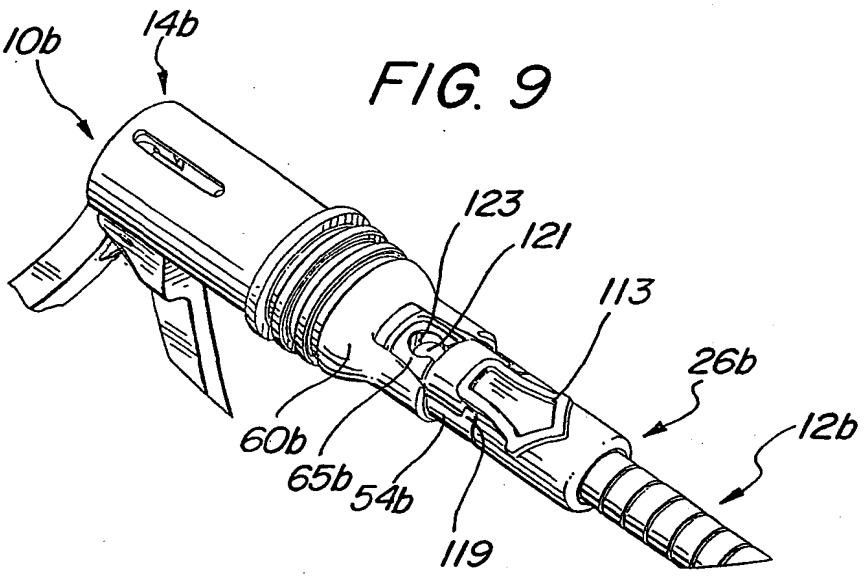
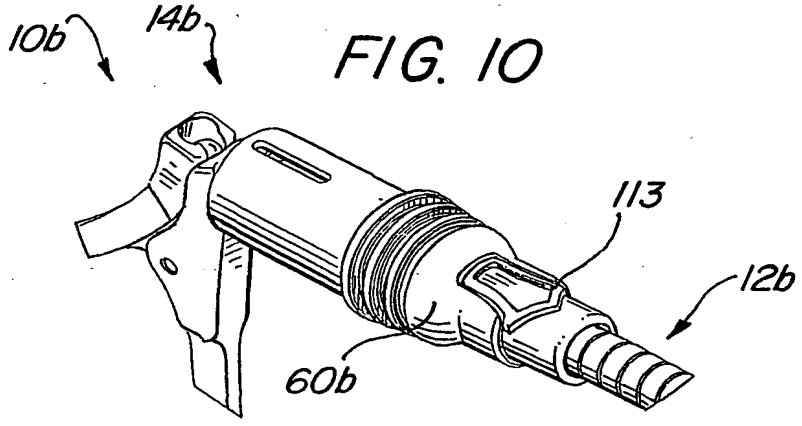


FIG. 10



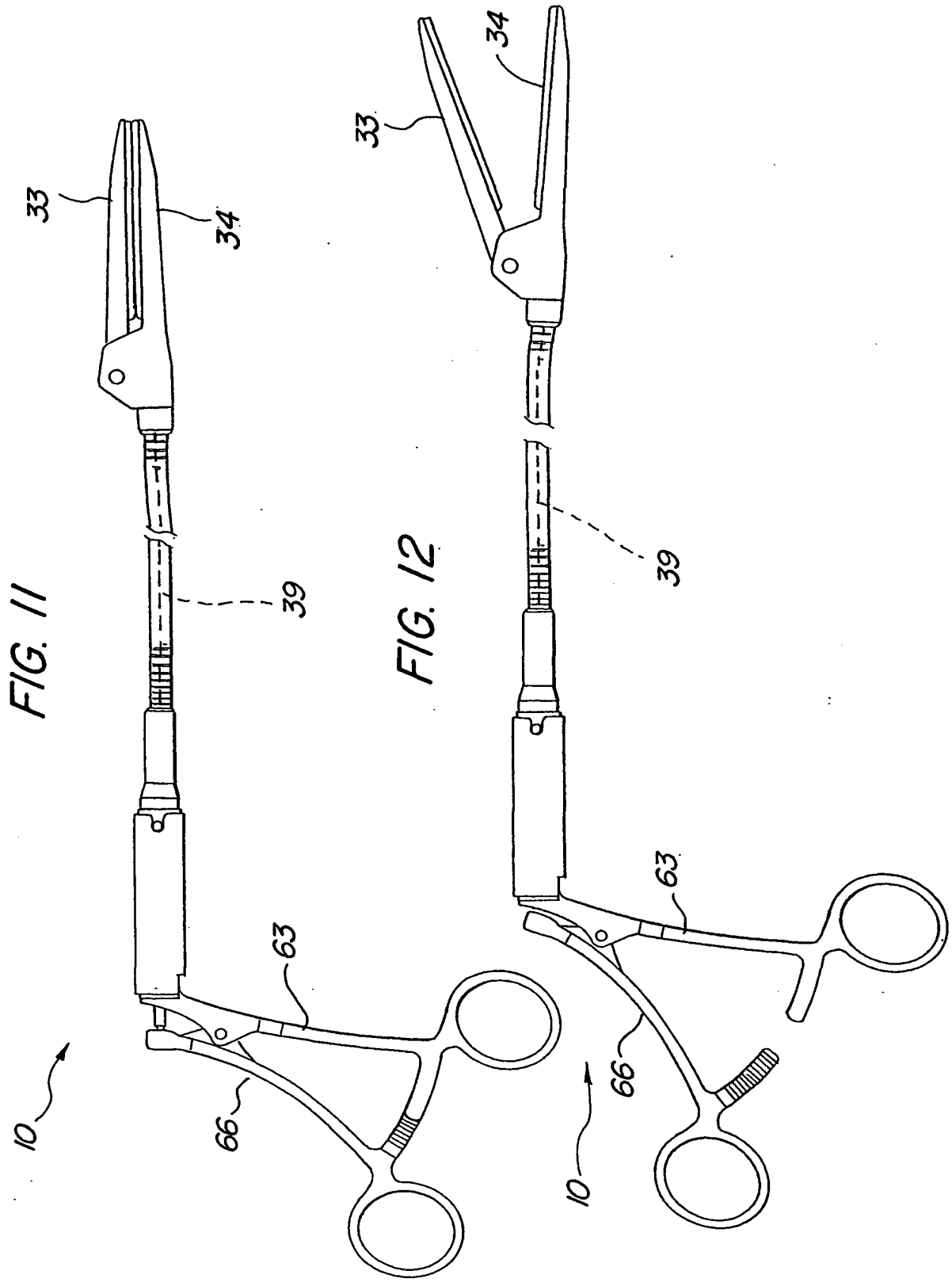


FIG. 11

FIG. 12

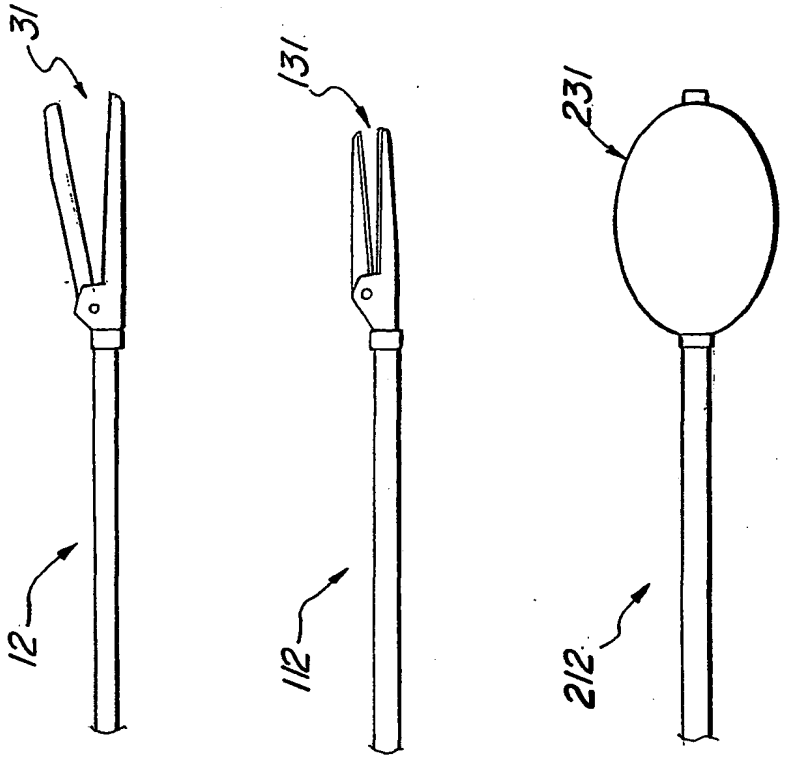
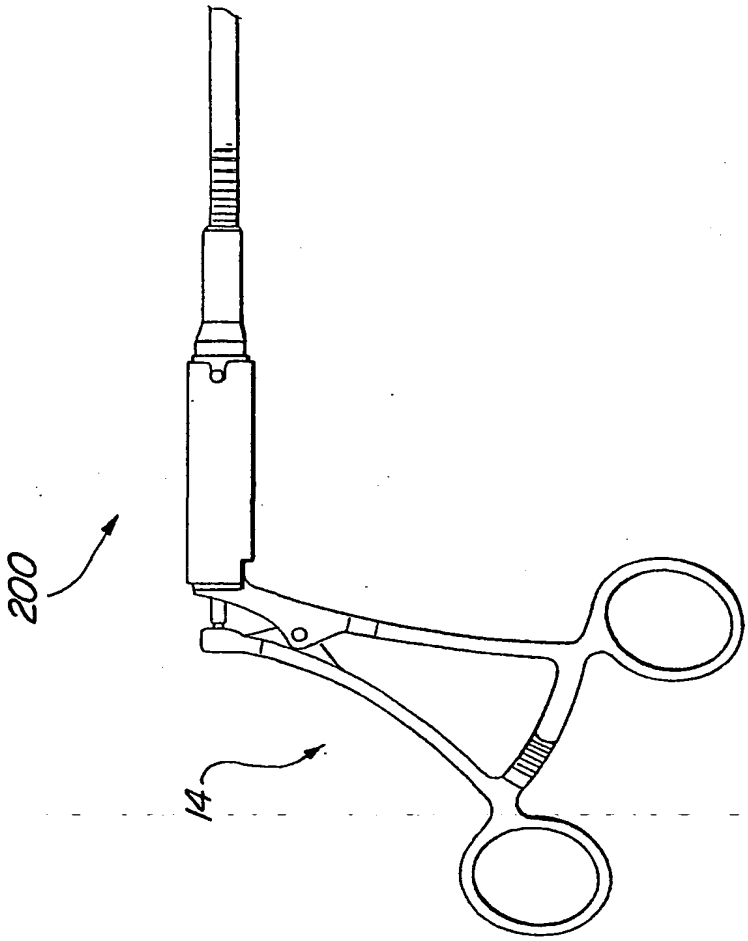


FIG. 13



INTERNATIONAL SEARCH REPORT

International application No.
PCT/US01/30089

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :A61B 17/42
US CL :606/205-209

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 606/205-209

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EAST

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,782,748 A (Palmer et al.) 21 July 1998, see figs. 2-15.	1-50N

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 17 DECEMBER 2001	Date of mailing of the international search report 25 JAN 2002
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer (JACKIE) TAN-UYEN THI HO Telephone No. (703) 306-3421

Form PCT/ISA/210 (second sheet) (July 1998)★